INDOOR AIR QUALITY ASSESSMENT

Buckland Town Offices
17 State Street
Buckland, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Center for Environmental Health
Emergency Response/Indoor Air Quality Program
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Background/Introduction

At the request of Sharon White (Franklin County Health Department) and Robert Deane (Town Administrator for the town of Buckland), the Massachusetts Department of Public Health's (MDPH) Center for Environmental Health (CEH) provided assistance and consultation regarding indoor air quality at the Buckland Town Offices (BTO), 17 State Street, Buckland, Massachusetts. Concerns about odors in the Assessor's office prompted the request. Michael Feeney, Director of CEH's Emergency Response/Indoor Air Quality (ER/IAQ) Program, initially visited the BTO on January 5, 2005.

Buckland town officials discovered that the chimney venting the new furnace was leaking into the Assessor's office (Picture 1). Air sampling by MDPH confirmed that the newly installed furnace was venting products of combustion into the building. A March 1, 2005 letter documented conditions found at the time of the January 6, 2005 visit and listed a number of recommendations to improve air quality (MDPH, 2005). As a result, repairs were made to the chimney to ensure proper venting of furnace exhaust. Mr. Feeney revisited the BTO on June 1, 2005 to determine whether mitigation efforts were successful.

The BTO are located in a two-story, clapboard-sided, wood frame building that was constructed in 1875. The addition of an elevator and restrooms were conducted in 2004 to the rear of the building. As part of these renovations a new heating, ventilating and air-conditioning (HVAC) system was installed, with the air-handling unit located in the attic. A new oil tank and furnace were also installed in the basement, directly below the Assessor's office. The furnace was connected to a pre-existing chimney. Windows are openable throughout the building.

Methods

Air tests for carbon dioxide, carbon monoxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor Model 8551.

Results

The BTO have an employee population of five and is visited by approximately 40 to 50 people daily. Tests were taken during normal operations and results appear in Table 1 for January 5, 2005 and Table 2 for June 1, 2005 results.

Discussion

Ventilation

It can be seen from the tables that carbon dioxide levels were below 800 parts per million (ppm) of air in all occupied areas surveyed on both days, which is indicative of adequate air exchange. However, a number of areas were unoccupied or sparsely populated, which can contribute to reduced carbon dioxide levels. Carbon dioxide levels would be expected to be higher with increased occupancy. Elevated levels of carbon dioxide were detected in unoccupied areas of the basement due to improper venting, which is explained in the Exhaust Emissions section of this report.

As mentioned, the air handling unit (AHU) located in the attic provides fresh air for the BTO. The AHU distributes conditioned air by a combination of ceiling and wall-mounted air diffusers connected via ductwork. Air returns to the AHU through ceiling-mounted exhaust grills via ductwork. The ventilation system is controlled by thermostats. Thermostats have a fan switch, which can be set to either “auto” or “on”. Setting the

thermostats to "auto" deactivates AHUs at a set temperature. In order to provide a continuous supply of fresh air, thermostats should be set to the "on" position during periods of occupancy.

To maximize air exchange, the MDPH recommends that both supply and exhaust ventilation operate continuously during periods of occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. The HVAC system was likely balanced in 2004 as part of the installation project. It is recommended that existing ventilation systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994).

The Massachusetts Building Code requires a minimum ventilation rate of 20 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times when the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air

(ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, please see Appendix A.

Temperature readings on January 6, 2005 ranged from 65° F to 68 ° F in occupied areas, which were below the MDPH recommended comfort guidelines. On June 1, 2005 temperature readings ranged from 73° F to 74 ° F, which were within the MDPH recommended comfort guidelines. The MDPH recommends that indoor air temperatures be maintained in a range of 70 ° F to 78 ° F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity on January 6, 2005 ranged from 21 to 24 percent in occupied areas, which was below the MDPH recommended comfort range. On June 1, 2005 the relative humidity ranged from 48 to 50 percent in occupied areas, which was within the MDPH recommended comfort range. The MDPH recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Please note relative humidity in the building would be expected to drop during the winter months due to heating. The sensation of

dryness and irritation is common in a low relative humidity environment. Low relative humidity is a common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

One water damaged ceiling tile was observed, which can indicate a leak from the roof or plumbing system. Water-damaged ceiling tiles can provide a source of mold and should be replaced after a water leak is discovered and repaired. The US Environmental Protection Agency and the American Conference of Governmental Industrial Hygienists (ACGIH) recommend that porous materials (e.g. ceiling tiles) be dried with fans and heating within 24 hours of becoming wet (US EPA, 2001; ACGIH, 1989). If porous materials are not dried within this time frame, mold growth may occur. Once mold growth has occurred, disinfection of some materials may be possible. Ceiling tiles are porous surfaces, so disinfection is likely to be ineffective.

Exhaust Emissions

The purpose of the June 1, 2005 visit was to conduct air sampling to ascertain whether repairs to the furnace and chimney were effective to vent combustion products from the building. The casing of the furnace had been repaired and a metal sheath with cap (Pictures 2 and 3) was installed inside the chimney to repair any gaps that may have existed in the chimney. The furnace was induced to fire during this evaluation in order to sample around the furnace in a similar manner to the January 6, 2005 assessment. Although, a slight rise in carbon dioxide was detected above the furnace while the furnace

was firing (Table 2), the June 1, 2005, measurements were significantly improved over the January 5, 2005, measurements.

MDPH staff also conducted measurements for carbon monoxide. *Carbon monoxide should not be present in a typical, indoor environment.* If it *is* present, indoor carbon monoxide levels should be less than or equal to outdoor levels. No measurable levels of carbon monoxide were detected during the January 5, 2005, and June 1, 2005 visits (Tables 1 and 2). In addition, no furnace-like odors were detected in the assessor's office or basement during the follow-up visit, unlike the January 5, 2005 assessment.

Building occupants reported periodic problems with vehicle exhaust migration into the BTO. An alley on the south wall of the BTO is used by local businesses to receive goods. Idling vehicles in close proximity to air intakes can result in the entrainment of vehicle exhaust into the building, which in turn may provide opportunities for exposure to compounds such as carbon monoxide. M.G.L. chapter 90 section 16A prohibits the unnecessary operation of the engine of a motor vehicle for a foreseeable time in excess of five minutes (MGL, 1996).

Conclusions/Recommendations

The air sampling results indicate that the repairs to the furnace casing and chimney are directing furnace exhaust outdoors. Based on the observations made during each visit, the following recommendations are made:

1. Consider posting signs instructing occupants/visitors about the anti-idling law. If problems persist consult with local law enforcement officials concerning

enforcement of the anti-idling statute. Other actions that could be employed would be to prohibit deliveries within the alleyway or limit deliveries in the alleyway to after BTO operating hours.

2. Ensure any leaks are repaired, and replace water damaged ceiling tiles. Examine the area above and around water-damaged areas for mold growth. Disinfect areas with an appropriate antimicrobial as needed.

3. Operate the HVAC system in the "on" setting to provide adequate fresh air year round.

References

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BOCA. 1993. The BOCA National Mechanical Code-1993. 8th ed. Building Officials & Code Administrators International, Inc., Country Club Hills, IL. M-308.1

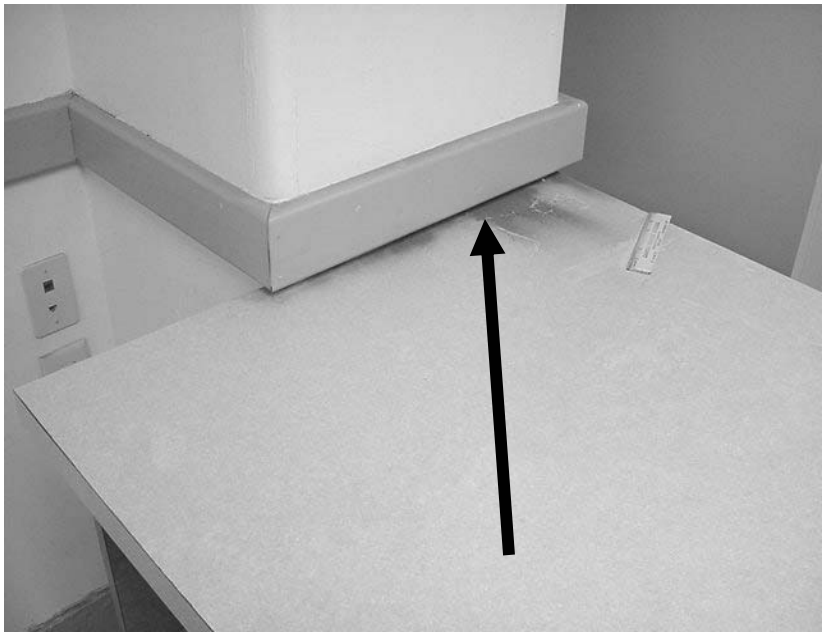
MGL. 1996. Stopped motor vehicles; Operation of Engine; Time Limit; Penalty. Massachusetts General Laws. M.G.L. c. 90:16A.

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R. 1910.1000 Table Z-1-A.

SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.

US EPA. 2001. Mold Remediation in Schools and Commercial Buildings. US Environmental Protection Agency, Office of Air and Radiation, Indoor Environments Division, Washington, D.C. EPA 402-K-01-001. March 2001.

Picture 1



Area of Chimney Leak in Assessor's Office

Picture 2

Chimney of BTH before Repair

Picture 3

Chimney of BTH after Repair, Note Cap

TABLE 1
Indoor Air Test Results
Buckland Town Hall, 17 State Road, Buckland, MA
January 5, 2005

Location	Carbon Dioxide (*ppm)	Carbon Monoxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation		Remarks
							Supply	Exhaust	
Outside (Background)	330	0	<32	33					
Assessor's office	408	0	65	24	0	Y	Y	Y	Furnace odor inside room Door open
Attic	447	0	59	21	0	N	N	N	Location of air handling unit Unoccupied space
Auditorium	364	0	62	22	0	Y	Y	Y	
Reception	440	0	66	22	1	Y	Y	Y	Door open
Town clerk	487	0	68	23	1	Y	Y	Y	1 water damaged ceiling tile Door open
Town administrator	397	0	67	21	0	Y	Y	Y	
Multi-program office	404	0	66	21	0	Y	Y	Y	Door open
Accountant	44	0	67	22	0	Y	Y	Y	Door open
Treasurer	439	0	67	22	0	Y	Y	Y	

*** ppm = parts per million parts of air**

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 1
Indoor Air Test Results
Buckland Town Hall, 17 State Road, Buckland, MA
January 5, 2005

Location	Carbon Dioxide (*ppm)	Carbon Monoxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation		Remarks
							Supply	Exhaust	
Basement at furnace not firing	1230	0							Unoccupied space
Basement at furnace with furnace firing	+ 6000	0							Unoccupied space

*** ppm = parts per million parts of air**

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 2
Indoor Air Test Results
Buckland Town Hall, 17 State Road, Buckland, MA
June 1, 2005

Location	Carbon Dioxide (*ppm)	Carbon Monoxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation		Remarks
							Supply	Exhaust	
Outside (Background)	371	0	74	50					
Reception	506	0	73	49	0	Y	Y	Y	Window open
Town clerk	573	0	74	49	1	Y	Y	Y	.
Town administrator	683	0	74	50	1	Y	Y	Y	
Multi-program office	648	0	74	49	1	Y	Y	Y	-
Treasurer	48	0	73	48	1	Y	Y	Y	Window open
Basement at furnace not firing	432	0							Unoccupied space
Basement at furnace with furnace firing	1050	0							Unoccupied space
Assessor's office prior to furnace firing	552	0	74	48	0	Y	Y	Y	

*** ppm = parts per million parts of air**

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 2
Indoor Air Test Results
Buckland Town Hall, 17 State Road, Buckland, MA
June 1, 2005

Location	Carbon Dioxide (*ppm)	Carbon Monoxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation		Remarks
							Supply	Exhaust	
Assessor's office after furnace firing, at area of leak	585	0	74	48	0	Y	Y	Y	

*** ppm = parts per million parts of air**

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%